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Japanese Published Unexamined (Kokai) Patent Application No. S58-90728, published May 30, 1983; Application No. S56-188654, filed November 25, 1981; Int. Cl.[3]: H01L 21/30 G03F 9/00; Inventor(s): Hiroo Kinoshita et al.; Assignee: Nippon Telegraph & Telephone Public Corporation; Japanese Title: Hansoutai Uefa jou no Ichiawase you Maaku oyobi sono Seizouhou (Positioning Mark on a Semiconductor Wafer and a Method for Production Thereof)

Specification

1. Title of Invention

Positioning mark on a Semiconductor Wafer and a Method for Production Thereof

2. Claim(s)

1. A positioning mark on a semiconductor wafer and a method for production thereof, characterized in that at least two regions such as a first region and a second region with an arc-shaped cross-section and multiple fine recesses arranged are arranged and formed in a predetermined location on a main surface of the semiconductor wafer, while leaving a third region with a flat surface extended on a straight line at an equivalent distance as that of the first and second regions.

2. A method for production of a positioning mark on a semiconductor wafer, characterized by being comprised of the following steps in the production process: a step of forming an etching mask layer with a pattern in a predetermined location on the main surface of the semiconductor wafer, wherein at least two mask layers such as a first mask layer and a second mask layer with multiple fine windows are arranged while leaving a linearly extended section; a step of forming the positioning mark wherein a first region and a second region with an arc-

shaped cross-section and multiple fine recesses arranged, which are located in a predetermined location on the main surface of the semiconductor wafer are arranged and formed while leaving a third region with a flat surface linearly extended at an equivalent distance as that of the first and second regions, by applying an isotropic etching on the semiconductor wafer using the etching mask layer.

3. A method for production of a positioning mark on a semiconductor wafer, as disclosed in Claim 2, characterized in that a plasma etching treatment is applied as the isotropic etching treatment.

3. Detailed Description of the Invention

(9) — When the main surfaces of semiconductor wafers are processed into a predetermined pattern, semiconductor regions with a predetermined pattern are formed inside the semiconductor wafers and when desired layers with a predetermined pattern are formed, masks with a predetermined pattern are formed on the semiconductor wafers. These masks are usually formed as follow. Material layers to be these masks are formed on the semiconductor wafers. Photoresist layers are then formed on the material layers. An exposure is applied to the photoresist layers using exposing masks with a predetermined pattern. After this, a developing treatment is applied to the exposed photoresist layers. By this developing treatment, masks with a predetermined pattern by the photoresist layers are formed. After an etching treatment has been applied to the material layers, the masks are obtained. Using photoresist layers as the material layers to be masks, an exposure is applied to the photoresist layers using exposing masks with a predetermined pattern. After this, a developing treatment

is applied to the exposed photoresist layers so as to obtain the masks.

(b) When masks with a predetermined pattern is formed on semiconductor wafers using exposing masks, a relative positioning between the semiconductor wafers and the exposing masks is required to be performed. With the relative positioning, positioning marks are necessary to be placed on the semiconductor wafers.

(c) Due to the necessity of the position marks, the present invention pertains to positioning marks on semiconductor wafers and a method for production thereof.

(d) As for these positioning marks on the semiconductor wafers, the following types are usually proposed: ends of oxide films adhered on the semiconductor wafers; cavities provided to the semiconductor wafers; through holes provided to the semiconductor wafers.

(e) However, when the positioning marks are the ends of the oxide films or the cavities in the semiconductor wafers, if semiconductor or metal films are formed onto the semiconductor wafers or if a thermal oxidation or etching treatment is applied to the semiconductor wafers before masks with a predetermined pattern are formed onto the semiconductor wafers using exposing masks, the positioning marks are damaged or the S/N of the positioning marks deteriorates due to a decrease of the contrast thereof.

(f) In addition to this disadvantage, when the positioning marks are the through holes on the semiconductor wafers, if the aforementioned treatment is applied before the masks with a predetermined pattern are formed on the semiconductor wafers using the exposing masks, the through holes as the positioning marks are embedded with other materials or the ends of the through holes are lost so as to deteriorate the S/N.

(g) Accordingly, the invention is to propose a positioning mark on a semiconductor wafer

with the disadvantages eliminated and a method for production thereof. The positioning mark of the present invention is described as below.

Fig.1 and Fig.2 illustrate an example of a positioning mark on a semiconductor wafer of the present invention. This positioning mark is constituted as follow. At least two regions such as a first region 4 and a second region 5 with an arc-shaped cross-section and multiple fine recesses 3 arranged are arranged and formed in a predetermined location on a main surface 2 of a semiconductor wafer 1, while leaving a third region 7 with a flat surface 6 extended on a straight line at an equivalent distance as that of the first and second regions. In this case, fine recesses 3 are extended adjacent to each other on a straight line.

The positioning mark with this constitution can be produced as shown in Fig.3.

A mask material layer 21 such as a thermal oxide film or a nitride film per se is formed at a 5000 Å thickness by using a conventional method (Fig.3 B). An etching mask layer 26 with a pattern per se is formed (Fig.3 B) on main surface 2 of semiconductor wafer 1 obtained in advance (Fig.3 A) by using a conventional photolithography, which is made of a photoresist material and which is arranged while leaving a section wherein at least two mask layers such as a first mask layer 23 and a second mask layer 24 with multiple windows 22 provided on mask material layer 21 are extended on a straight line.

Following this, by applying an etching treatment to mask material layer 21 so that etching mask layer 26 is used as a mask, an etching mask layer 31 with a pattern arranged while leaving a section 30 wherein first and second mask layers 28 and 29 with multiple fine windows 27 arranged are extended on a straight line, which are formed with mask material layer 21 and which correspond to etching mask layer 26. Mask layer 26 is then removed (Fig.3

D).

Next, by applying a plasma etching treatment to semiconductor wafer 1 as an isotropic etching treatment using an etching mask layer 31 as a mask, the positioning mark as shown in Fig.1 and Fig.2 is formed (Fig.3 E). After this, mask layer 31 removed from the surface of semiconductor wafer 1 so as to obtain a desired positioning mark as shown in Fig.1 and Fig.2 (Fig.3 F).

The embodiment illustrating the positioning mark of the invention and the producing method thereof is described above. According to the positioning mark of the invention as shown in Fig.1 and Fig.2, fine recesses 3 in first and second regions 4 and 5 have an arc-shaped cross-section (a circular arc cross-section with an about 1 to 5 μm diameter). Due to this arc-shaped cross-section, no positive reflection occurs in recesses 3. However, there is a positive reflection on flat surface 6 in third region 7. Thus, the positioning mark functions as one with a high contrast and also do not have any disadvantages associated with prior art positioning mark as mentioned above.

According to the producing method for the positioning mark of the invention as shown in Fig.3, the aforementioned characteristic positioning mark is easily achieved at an extremely simple process as described above.

The embodiment is merely one of the examples of the invention. As shown in Fig.4 and Fig.5, four regions as similarly to first regions 4 and 5 of Fig.1 and Fig.2 can be formed as regions 41, 42, 43 and 44. Corresponding to these regions, a region 45 that orthogonalizes region 7 of Fig.1 and Fig.2 in a cross shape can be also formed. Additionally, various modifications and changes can be applied.

4. Brief Description of the Invention

Fig.1 and Fig.2 are a schematic top view and a horizontal cross-sectional view illustrating an example of the invention. Fig.3 is a cross-sectional view illustrating an example of a method for production of the invention. Fig.4 and Fig.5 are a schematic top view and a cross-sectional view illustrating the other example of the invention.

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